

NOTE ON THE TEMPERATURE OF *ECHIDNA*
ACULEATA.

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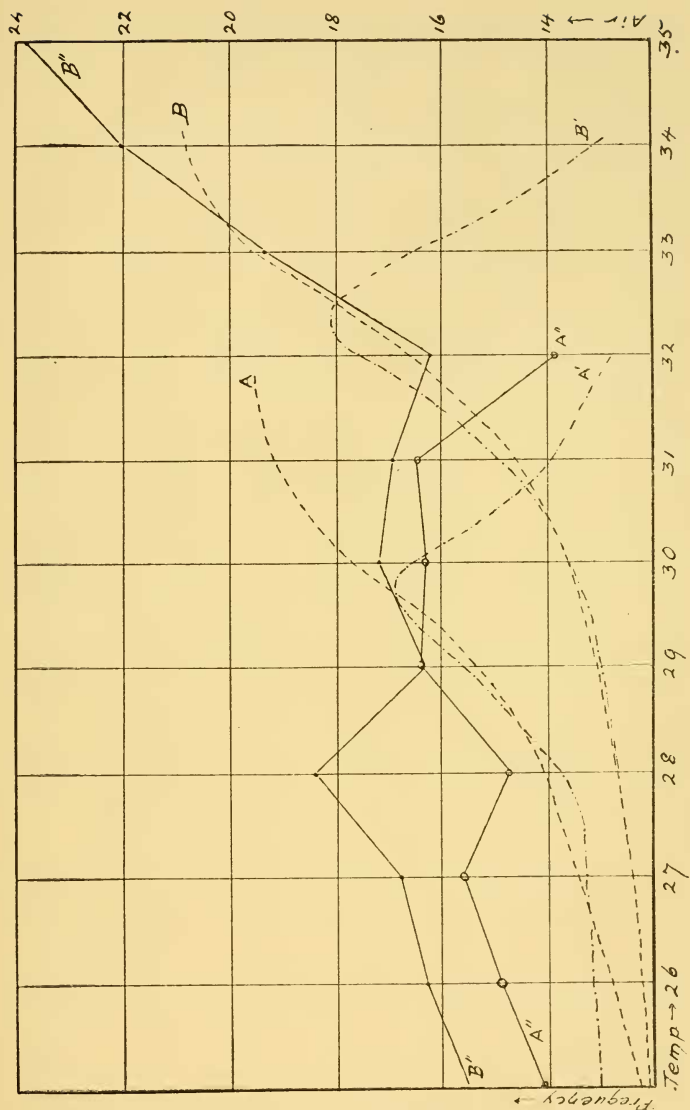
(From the Physiological Laboratory of the University of Sydney.)

(With two Text-figures).

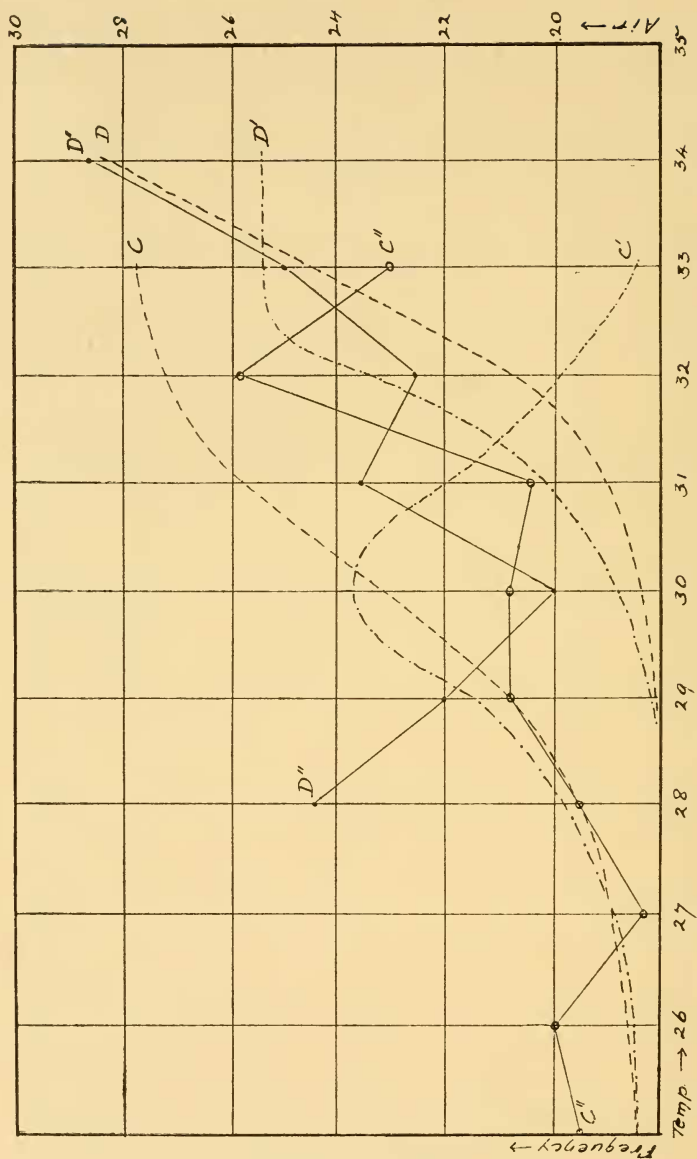
In a previous communication, the present writer has recorded a number of observations of the rectal temperature of *Echidna aculeata* (Wardlaw, 1915). The observations were made at different times of the day, and during different seasons of the year. As the temperatures showed considerable variations, even outside of the periods during which the animals were hibernating, some difficulty was experienced in arriving at an estimate of their normal waking temperature. Average values calculated from results varying like those obtained have no precise meaning. Yet to give the range of variation alone is hardly sufficient: a central value is necessary as a point of departure.

These results, therefore, have been submitted to a further examination, in which the graphic method of statistical analysis, due to Galton, has been applied in the manner described in a former paper (Wardlaw, 1917). In this way, it has been shown that the observations of temperature are not distributed at random over their whole range of variation, but occur more frequently in the vicinity of certain values, and that the temperature of this animal has certain definite most probable values for different times of the day at different seasons of the year.

In the accompanying diagrams (Text-figs. 1 and 2), the frequency of occurrence of different temperatures of *Echidna*, outside of the periods of hibernation, have been plotted. Temperatures of the animals are measured along the abscissæ. The relative



Text-fig. 1. (See p. 849).



Text-fig. 2. (See p. 849).

frequencies of occurrence of the various temperatures are proportional to the ordinates. Autumn and winter temperatures are given in Text-fig.1; spring and summer temperatures are given in Text-fig.2. The morning and afternoon temperatures are plotted separately in each diagram. The mean air-temperatures, corresponding to each range of $1^{\circ}\text{C}.$ of the animal's temperatures, are also shown. The numbers of results represented by each of the four pairs of curves are as follows: autumn-winter period, morning, 188, afternoon, 242; spring-summer period, morning, 98, afternoon, 102. As these numbers are different, the ordinates of the different curves are not directly comparable with each other. This does not matter, however, as only the different ordinates of the same curve require to be compared.

Curve A, Text-fig.1, shows the ogive of the morning temperatures of *Echidna* during the autumn-winter period. Each ordinate is proportional to the number of observations occurring at and below the corresponding temperature. Curve A' is the derived or frequency-curve; each ordinate is proportional to the number of observations occurring at the corresponding temperature. It will be seen that the maximum of this frequency-curve lies at $29.7^{\circ}\text{C}.$: this is the most probable morning-temperature of *Echidna* during the autumn-winter period. It will also be noticed that the curve A' flattens out and becomes almost horizontal below a temperature of about $27.6^{\circ}\text{C}.$ This portion of the curve continues down to about $8.0^{\circ}\text{C}.$, but has not all been shown. The curve indicates that, below $27.6^{\circ}\text{C}.$, *Echidna* allows its temperature to vary at random, and displays no tendency to bring it towards a definite value. By the time its body-temperature has fallen to $27.5^{\circ}\text{C}.$, *Echidna* has thus become a completely poikilothermal animal.

The line A'' joins the mean air-temperatures corresponding to the different body-temperatures of *Echidna*, and is marked by circles.

Curve B, Text-fig.1, is the ogive of the afternoon-temperatures of *Echidna* during the autumn-winter period. Curve B' is the corresponding frequency-curve. Its maximum occurs at $32.3^{\circ}\text{C}.$,

and this is the most probable afternoon-temperature of *Echidna* during the period in question. The line B" joins the air-temperatures corresponding to the different temperatures of *Echidna*, and is indicated by dots.

Curve C, Text-fig.2, is the ogive of the morning-temperatures of *Echidna* during the spring-summer period. C' is the corresponding frequency-curve. Its maximum lies at 30.0°C., and this is the most probable morning-temperature of *Echidna* during spring and summer. The line C" joins the average air-temperatures as before, and is indicated by circles.

Curve D, Text-fig.2, is the ogive of the afternoon-temperatures of *Echidna* during the spring-summer period. D' is the corresponding frequency-curve. The curve, it will be noticed, does not fall after rising to its maximum, but remains constant. The maximal value is reached at a temperature of 32.6°C. Above this temperature the frequency-curve is horizontal, and the temperature of *Echidna* varies at random. These facts indicate that there is an upper, as well as a lower, limit of temperature beyond which the temperature-regulating mechanism breaks down, and *Echidna* behaves as a poikilothermal animal. This mechanism is only effective while the animal's body-temperature lies between about 27.6°C. and 32.6°C., that is, over a range of variation of about 5°C.

The line D" joins the average air-temperatures corresponding to the different afternoon-temperatures of *Echidna* during the spring-summer period.

The four curves show, that most probable temperatures of *Echidna* are 2.6°C. lower in the morning than in the afternoon during both of the periods in which the observations were made.

The most probable temperatures of the spring-summer period were very slightly (0.3°C.) higher than the corresponding temperatures of the autumn-winter period. The average air-temperatures were about 5°C. higher in the former than in the latter period.

SUMMARY.

The most probable temperatures of *Echidna* are: in the morning, 29.7°C . during autumn and winter; 30.0°C . during spring and summer. In the afternoon, 32.3°C . during autumn and winter; 32.6°C . during spring and summer.

The temperature-regulating mechanism of *Echidna* is only effective while the body-temperature lies between 27.6°C . and 32.6°C . Outside of these limits, *Echidna* behaves as a poikilothermal animal.

REFERENCES.

GALTON.—Natural Inheritance. London, 1889.

WARDLAW.—Proc. Linn. Soc. N. S. Wales, 1915, xl., p.231.

—————*Ibid.*, 1917, xlii., p.815.

LEGENDS OF TEXT-FIGURES.

Text-fig.1 (p.845).

Relative frequency of occurrence of different autumn and winter temperatures of *Echidna*. Abscissae, body-temperatures of *Echidna*. Ordinates of curves A and B are proportional to numbers of observations at and below the corresponding temperatures. Ordinates of curves A' and B' are proportional to numbers of observations at the corresponding temperatures. The points joined by the lines A'' and B'' indicate the average air-temperatures corresponding to each degree range of body-temperature. Letters A, A', A'' refer to morning-temperatures; letters B, B', B'' to afternoon-temperatures.

Text-fig.2 (p 847).

Relative frequency of occurrence of different spring and summer temperatures of *Echidna*. Abscissae, body-temperatures of *Echidna*. Ordinates of curves C and D are proportional to numbers of observations at and below corresponding temperatures. Ordinates of curves C' and D' are proportional to numbers of observations occurring at the corresponding temperatures. The points joined by the lines C'' and D'' indicate the average air-temperatures corresponding to each degree range of body-temperature. Letters C, C', C'' refer to morning-temperatures; letters D, D', D'' to afternoon-temperatures.